

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

B/IRW

Applicant: Dinesh Chopra

Title: COMBINED BARRIER LAYER AND SEED LAYER

Docket No.: 303.658US1

Filed: April 19, 2001

Examiner: Khiem D Nguyen

Serial No.: 09/838,493

Due Date: N/A

Group Art Unit: 2823



MS AF

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

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 An Interview Summary (13 Pages).

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By: David R. Cochran  
Atty: David R. Cochran  
Reg. No. 46,632

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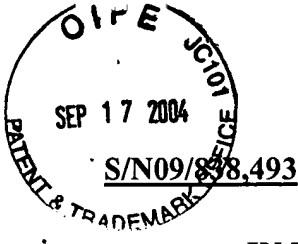
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SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

(GENERAL)



PATENT

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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**INTERVIEW SUMMARY**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

A telephone conversation was held between Examiner Khiem Nguyen and Applicant's representative, David R. Cochran, on 14 September 2004 to discuss the status of claims 1-9, 11-14, 16-41, and 43-57 now pending in the instant application. In particular, proposed amendments to the claims that were generated from telephone conversations during the week of 23 August 2004 were discussed. The discussions during the week of 23 August were held to clarify the Advisory Action mailed 4 August 2004. Agreement was reached on the language of the claims that places the claims in condition for allowance. Examiner Nguyen indicated that he would execute an Examiner's Amendment to facilitate the wording changes. Included in this interview summary is a copy of the proposed claim changes including the wording changes of 14 September. Do not enter the attached copy of proposed claim changes, which are provided as a copy of changes discussed in the telephonic meetings.

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully Submitted,

DINESH CHOPRA

By his Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.  
P.O. Box 2938  
Minneapolis, MN 55402  
(612) 371-2157

Date 14 September 2004 By \_\_\_\_\_

  
David R. Cochran  
Reg. No. 46,632

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Name Tina Kohout

Signature ZKH

### CONFIRMATION OF PROPOSED CHANGES

1. (Amendment Confirmation) A method of metallizing a substrate, comprising:
  - depositing a dual-purpose layer on the substrate wherein a first purpose is to serve as a barrier layer and a second purpose is to serve as a seed layer;
  - electrochemically reducing oxides on the surface of the dual-purpose layer using a first electrolyte where the first electrolyte includes a cation species of material of an anode in an electrochemical reaction cell; and
  - electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer using a second electrolyte, wherein the conductive interconnect layer includes conductive material other than the cation species in the first electrolyte used to electrochemically reduce the oxides, wherein the anode is formed from titanium or titanium/platinum.
2. (Original) The method of claim 1, wherein the dual-purpose layer comprises a material capable of reducing diffusion of the conductive interconnect material into surrounding materials, and wherein the dual-purpose layer comprises a material having a resistivity that allows electrochemical deposition of the conductive interconnect material.
3. (Original) The method of claim 1, wherein the dual-purpose layer comprises a material selected from the group consisting of tungsten, tungsten nitride, and tungsten-silicon nitride.
4. (Original) The method of claim 1, wherein the material comprising the dual-purpose layer comprises tungsten.
5. (Original) The method of claim 1, wherein the conductive interconnect material comprises copper.
6. (Original) The method of claim 1, wherein a voltage of at least about 0.1 V and not more than about 1 V is applied during both the electrochemically reducing step and the

electrochemically depositing step for a time period of from about 30 seconds to about 5 minutes.

7. (Original) The method of claim 1, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 5 mA/cm<sup>2</sup> to about 25 mA/cm<sup>2</sup> is applied during both the electrochemically reducing step and the electrochemically depositing step.

8. (Original) The method of claim 1, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 10 mA/cm<sup>2</sup> to about 15 mA/cm<sup>2</sup> is applied during both the electrochemically reducing step and the electrochemically depositing step.

9. (Original) The method of claim 1, wherein a current of from about 0.5 amps to about 10 amps and having a current density of about 12 mA/cm<sup>2</sup> is applied during both the electrochemically reducing step and the electrochemically depositing step.

10. (Canceled)

11. (Amendment Confirmation) The method of claim [[12]] 47, wherein the anode is formed from titanium or titanized platinum titanium/platinum.

12. (Amendment Confirmation) A method of metallizing a substrate, comprising:  
depositing a dual-purpose layer on the substrate wherein a first purpose is to serve as a barrier layer and a second purpose is to serve as a seed layer;  
electrochemically reducing oxides on the surface of the dual-purpose layer in an electrochemical reaction cell comprising an anode formed from a material that can be oxidized in the presence of the material comprising the dual-purpose layer;  
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer; and  
wherein the electrochemical reaction cell contains a first electrolyte comprising the cation of the material used to form the anode, and the conductive interconnect layer includes conductive

material other than the cation species in the first electrolyte used to electrochemically reduce the oxides, wherein the anode is formed from titanium or titanium/platinum.

13. (Previously Presented) The method of claim 12, wherein the anode comprises titanium and the first electrolyte comprises titanium trichloride, titanium sulfate, titanium bromide, titanium trichloride, titanium iodide, titanium fluoride, or mixtures thereof.

14. (Original) The method of claim 13, wherein the first electrolyte comprises titanium trichloride or titanium sulfate.

15. (Canceled)

16. (Previously Presented) The method of claim 25, wherein the electrochemically reducing step is performed in a first electrochemical reaction cell and the electrochemically depositing step is performed in a second electrochemical reaction cell.

17. (Previously Presented) The method of claim 25, wherein the electrochemically reducing step and the electrochemically depositing step are performed in a single electrochemical reaction cell.

18. (Previously Presented) The method of claim 25, wherein the electrochemical reducing step is performed using a first anode and the electrochemical depositing step is performed using a second anode.

19. (Previously Presented) The method of claim 25, wherein the electrochemical reducing step and the electrochemical depositing step are performed using a single anode.

20. (Previously Presented) The method of claim 25, wherein the dual-purpose layer comprises a material selected from the group consisting of tungsten, tungsten nitride, and

tungsten-silicon nitride.

21. (Previously Presented) The method of claim 25, wherein the material comprising the dual-purpose layer comprises tungsten.

22. (Previously Presented) The method of claim 25, wherein the conductive interconnect material comprises copper.

23. (Previously Presented) The method of claim 25, wherein the first anode comprises a material that can be oxidized in the presence of the material comprising the dual-purpose layer.

24. (Amendment Confirmation) The method of claim 25, wherein the anode is formed from titanium or titanized platinum titanium/platinum, platinum, or copper.

25. (Amendment Confirmation) A method of metallizing a substrate, comprising:  
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;  
electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte in an electrochemical bath having an anode and a cathode;  
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte; and  
wherein the first electrolyte contains the cationic species of the material comprising the first anode, and the conductive interconnect layer includes conductive material other than the cation species in the first electrolyte used to electrochemically reduce the oxides, wherein the anode is formed from titanium, platinum, or titanium/platinum.

26. (Amendment Confirmation) A method of metallizing a substrate, comprising:  
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as

a barrier layer and a seed layer;

electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte;

electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte; and

wherein the first electrolyte comprises titanium sulfate, titanium bromide, titanium trichloride, titanium iodide, titanium fluoride, or mixtures thereof, wherein an anode used to electrochemically reduce oxides is formed from titanium/platinum.

27. (Previously Presented) A method of metallizing a substrate, comprising:

depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;

electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte in an electrochemical cell having an anode;

electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte; and

wherein the first anode is formed from titanium and the first electrolyte is titanium chloride or titanium sulfate.

28. (Previously Presented) The method of claim 25, wherein a voltage of at least about 0.1 V and not more than about 1 V is applied during both the electrochemically reducing step and the electrochemically depositing step for a time period of from about 30 seconds to about 5 minutes.

29. (Previously Presented) The method of claim 25, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 5 mA/cm<sup>2</sup> to about 25 mA/cm<sup>2</sup> is applied during both the electrochemically reducing step and the electrochemically depositing step.

30. (Previously Presented) The method of claim 25, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 10 mA/cm<sup>2</sup> to about 15 mA/cm<sup>2</sup> is applied during both the electrochemically reducing step and the electrochemically depositing step.

31. (Previously Presented) The method of claim 25, wherein a current of from about 0.5 amps to about 10 amps and having a current density of about 12 mA/cm<sup>2</sup> is applied during both electrochemically reducing step and the electrochemically depositing step.

32. (Amendment Confirmation) A method of metallizing a substrate, comprising:  
depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;  
electrochemically reducing oxides on the surface of the dual-purpose layer utilizing a first electrolyte where the first electrolyte includes a cation species of material of an anode in an electrochemical reaction cell, wherein the anode is formed from titanium or titanium/platinum;  
electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer utilizing a second electrolyte, the conductive interconnect layer including conductive material other than a cation species in the first electrolyte used to electrochemically reduce the oxides; and

wherein the second electrolyte comprises:

the cation of the material from which the conductive interconnect layer is made;  
a complexing agent; and  
a pH control agent.

33. (Previously Presented) The method of claim 32, wherein the conductive interconnect layer comprises copper and the second electrolyte comprises copper sulfate.

34. (Original) The method of claim 32, wherein the complexing agent is selected from the group consisting of ethylene diamine tetra acetate, boric acid, and malonic acid.

35. (Original) The method of claim 32, wherein the complexing agent is ethylene diamine tetra acetate.

36. (Original) The method of claim 32, wherein the pH control agent is tetramethyl ammonium hydroxide, ammonium hydroxide, or potassium hydroxide.

37. (Original) The method of claim 32, wherein the pH control agent is tetramethyl ammonium hydroxide.

38. (Original) The method of claim 32, wherein the electrolyte exhibits a pH greater than about 7.

39. (Original) The method of claim 32, wherein the electrolyte exhibits a pH greater than or equal to about 10.

40. (Original) The method of claim 32, wherein the electrolyte exhibits a pH greater than about 7 and less than or equal to about 12.

41. (Original) The method of claim 32, wherein the electrolyte exhibits a pH greater than about 10 and less than or equal to about 12.

42. (Canceled)

43. (Previously Presented) The method of claim 44, wherein the dual-purpose layer comprises tungsten.

44. (Amendment Confirmation) A method of metallizing a substrate, comprising:
- depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
- electrochemically reducing oxides on the surface of the dual-purpose layer;
- electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer, wherein both the electrochemically reducing step and the electrochemically depositing step are performed in a single electrochemical reaction cell utilizing a single electrolyte where the single electrolyte includes a cation species of material of an anode in the electrochemical reaction cell, wherein the anode is formed from titanium, platinum, or titanium/platinum;
- wherein the electrolyte comprises:
- the cation of the material from which the conductive interconnect material is made;
- a complexing agent; and
- a pH control agent; and
- injecting a second electrolyte into the single electrochemical reaction cell after electrochemically depositing the conductive interconnect layer to an initial thickness to deposit additional material to thicken the layer of conductive interconnect layer to a selected thickness.

45. (Amendment Confirmation) A method of metallizing a substrate, comprising:
- depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;
- electrochemically reducing oxides on the surface of the dual-purpose layer;
- electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer, wherein both the electrochemically reducing step and the electrochemically depositing step are performed in a single electrochemical reaction cell utilizing a single electrolyte where the single electrolyte includes a cation species of material of an anode in an electrochemical reaction cell, wherein the anode is formed from titanium or titanium/platinum;

wherein the electrolyte comprises:

the cation of the material from which the conductive interconnect material is made;

a complexing agent; and

a pH control agent; and

wherein the conductive interconnect material comprises copper and the electrolyte comprises copper sulfate.

46. (Original) The method of claim 44, wherein the complexing agent is selected from the group consisting of ethylene diamine tetra acetate, boric acid, and malonic acid.

47. (Amendment Confirmation) A method of metallizing a substrate, comprising:

depositing a dual-purpose layer on the substrate wherein the dual-purpose layer serves as a barrier layer and a seed layer;

electrochemically reducing oxides on the surface of the dual-purpose layer;

electrochemically depositing a conductive interconnect layer on the surface of the dual-purpose layer, wherein both the electrochemically reducing step and the electrochemically depositing step are performed in a single electrochemical reaction cell utilizing a single electrolyte where the single electrolyte includes a cation species of material of an anode in an electrochemical reaction cell;

wherein the electrolyte comprises:

the cation of the material from which the conductive interconnect material is made;

a complexing agent; and

a pH control agent; and

wherein the complexing agent is ethylene diamine tetra acetate, wherein the anode is formed from titanium, platinum, or titanium/platinum.

48. (Original) The method of claim 44, wherein the pH control agent is tetramethyl ammonium hydroxide, ammonium hydroxide, or potassium hydroxide.

49. (Original) The method of claim 44, wherein the pH control agent is tetramethyl ammonium hydroxide.

50. (Original) The method of claim 44, wherein the electrolyte exhibits a pH greater than about 7.

51. (Original) The method of claim 44, wherein the electrolyte exhibits a pH greater than or equal to about 10.

52. (Original) The method of claim 44, wherein the electrolyte exhibits a pH greater than about 7 and less than or equal to about 12.

53. (Original) The method of claim 44, wherein the electrolyte exhibits a pH greater than about 10 and less than or equal to about 12.

54. (Previously Presented) The method of claim 44, wherein a voltage of at least about 0.1 V and not more than about 1 V is applied during both the electrochemically reducing step and the electrochemically depositing step for a time period of from about 30 seconds to about 5 minutes.

55. (Previously Presented) The method of claim 44, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 5 mA/cm<sup>2</sup> to about 25 mA/cm<sup>2</sup> is applied during both the electrochemically reducing step and the electrochemically depositing step.

56. (Previously Presented) The method of claim 44, wherein a current of from about 0.5 amps to about 10 amps and having a current density of from about 10 mA/cm<sup>2</sup> to about 15 mA/cm<sup>2</sup> is applied during both the electrochemically reducing step and the electrochemically

depositing step.

57. (Previously Presented) The method of claim 44, wherein a current of from about 0.5 amps to about 10 amps and having a current density of about 12 mA/cm<sup>2</sup> is applied during both the electrochemically reducing step and the electrochemically depositing step.

58.-94. (Canceled)